Critical Success Factors for Sal Remediation Policy: A Meta-Analytic Comparison of Dutch Experiences

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A comparative evaluation

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CRITICAL SUCCESS FACTORS FOR OFFSHORE AIRPORTS
A COMPARATIVE EVALUATION

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Abstract

The booming aviation sector is worldwide increasingly faced with capacity constraints at both the land and air side. In recent years various countries have tried to overcome the land-based bottlenecks by the design and construction of new offshore airports. This paper aims to identify and assess the critical success factors for two recently built island airports, viz. in Hong Kong and Osaka. The analysis addresses success conditions at both the corporate and the regional level. The methodological basis for the comparative investigation deploys the so-called pentagon prism. The results show that island airports may seem to offer a favorable land use and environmental solution, but face at the same time severe financial and maritime ecology problems.

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1. Setting the Scene

In a modem global network economy international connections are at a rising edge. This is particularly reflected in the dynamic growth pace of air transport (see inter alia Button 1991, Button and Stough 2000, Button et al. 1998, Oum and Yu 1998, Pels 2000). More people tend to fly, and they travel more frequently and also over longer distances. The booming aviation industry has clearly prompted the need for huge investments in both aircraft and airports in order to accommodate the mobility drift of mounting numbers of air passengers. The liberalization of air transport in many countries has also led to the entry of more newcomers, so that as a result of increased competition airfares tend to fall (see also Bruinsma et al. 2000 and Doganis 1992). Many airports do not have sufficient capacity to handle the increasing volume of travelers and have to seek for creative ways of expanding capacity, e.g. through better logistics or physical airport expansion. The traditional way of just using more land for airport expansion is – as a result of environmental constraints and public resistance - increasingly problematic. In the past, cities located near the coast have often tried to release the land use constraints by constructing semi-offshore airports (e.g. Nice, Boston, Eilat, Singapore). More recently, we have observed a novel phenomenon, viz. the construction of offshore airports located on new artificial islands off the coast (Hong Kong, Osaka).

It goes without saying that spending a large amount of (often public) money on a risky investment is not an easy matter. Recent failures of newly built airports (such as Denver, or Mirabel near Montreal) have made public decision-makers extremely cautious and risk-avert. But the private sector is equally reluctant to get involved in uncertain financial adventures. And therefore, a careful analysis of such mega-investments is warranted.

After the construction and opening of new island airports, viz. Hong Kong and Osaka, also various other cities got interested in building such an island airport, viz. Seoul and Nagoya. Furthermore, in other places (Amsterdam, Tel Aviv) extensive discussions took place on building artificial airport islands off the coast. In light of the above observations it seems plausible that more countries will consider offshore airport locations. Hence, it is extremely important to critically evaluate the recent experiences concerning island airports.

This paper will address the critical success (or failure) factors for offshore airports. After a concise review of the current situation regarding island airports, the methodology of the pentagon prism analysis will be used to evaluate and compare two major experiences, viz. Hong Kong and Osaka. This will be done at the level of both the airport as a corporate business and of the region where the airport is located. The paper will be concluded with some policy suggestions and lessons.

2. Offshore Airport Locations

An airport is not just a physical location of runways, but constitutes a logistic node in a larger network. The recent trend towards hub-and spoke systems illustrates the

strategic importance of various international airports. Lack of access to an international aviation network means a significant loss of competitive ability and opportunity. It is therefore no surprise that airports faced with a serious capacity constraint (caused by either physical constraints or environmental constraints) have attempted to alleviate such impediments to further growth by seeking for alternatives, in particularly physical expansion or spatial displacement. In the past years the idea of island airports has attracted much attention, after the opening of two major airports, viz. Kansai International Airport near Osaka (since 1994) and Chek Lap Kok near Hong Kong (since 1998). These new airports are located at a far distance from the city-center and are less hampered by noise restrictions, although it has to be added that the ecological disturbance to the marine environment is certainly not insignificant (leave aside the visual pollution).

It is noteworthy that in the years to come two more large-scale offshore airports will be opened, viz. the New Seoul Metropolitan Airport and the Central Japan International Airport near Nagoya. Since also elsewhere in the world plans for an island location of airports have been launched, it is evident that careful judgment of the advantages and disadvantages of such new logistic concepts is needed (see also Castricum 1997) Clearly, the motives for offshore airport locations may be different, and range from safety or environmental constraints to technical capacity constraints (se also Yim 2000).

In the case of Hong Kong, the former Kai-Tak airport suffered from severe congestion, while expansion of the location in the middle of the densely populated Kowloon area was impossible; also the complicated flight path to be followed and the flight manoeuvers between various apartment blocks necessitated a relocation. The new airport, north of Landau Island, was largely constructed on an artificial island. It is noteworthy that this island location did not only involve an operation of a new airport, but also a shift of the container harbor of Hong Kong to a nearby location, while in a few years time also a new Disney theme park will opened in the vicinity. Finally, at some distance also residential building complexes are foreseen. This airport did not start under favorable conditions, as the Asian crisis and the financial situation of its major carrier, Cathay Pacific, caused a serious blow to this project.

The Kansai International Airport in Osaka has a quite different history. It was meant to substitute Osaka International airport, which was - because of its central location near the city - producing too much noise annoyance. At present both airports are in operation; the older one is used for regional connections and was never closed down because of fear for losing employment. The new airport serves mainly international destinations. Kansai International Airport has a somewhat problematic position; the construction of an artificial island five kilometers southeast off the coast in Osaka Bay caused major technical problems, while at present there is only one runway available. The high costs do not make this new airport a profitable undertaking (see also Sakakibara 1993, 1998).

In addition to the above mentioned island airports, also two island initiatives for aviation are under construction. The first one is the New Seoul Metropolitan Airport in South Korea, which may substitute the old Kimpo Airport. The location of this new airport is particularly favorable if the two Korea's would re-unite. Otherwise, it would be a somewhat isolated project. Next, the Central Japan International Airport near Nagoya in the Japanese region of Chubu, one of the industrial centers in Japan, has to be mentioned. It will modestly start with one runway in the year 2005 (see for details also central Japan International Airport Co. 1999). In general, new island airports seem to be particularly popular in Asia, especially in densely populated metropolitan areas near the sea.

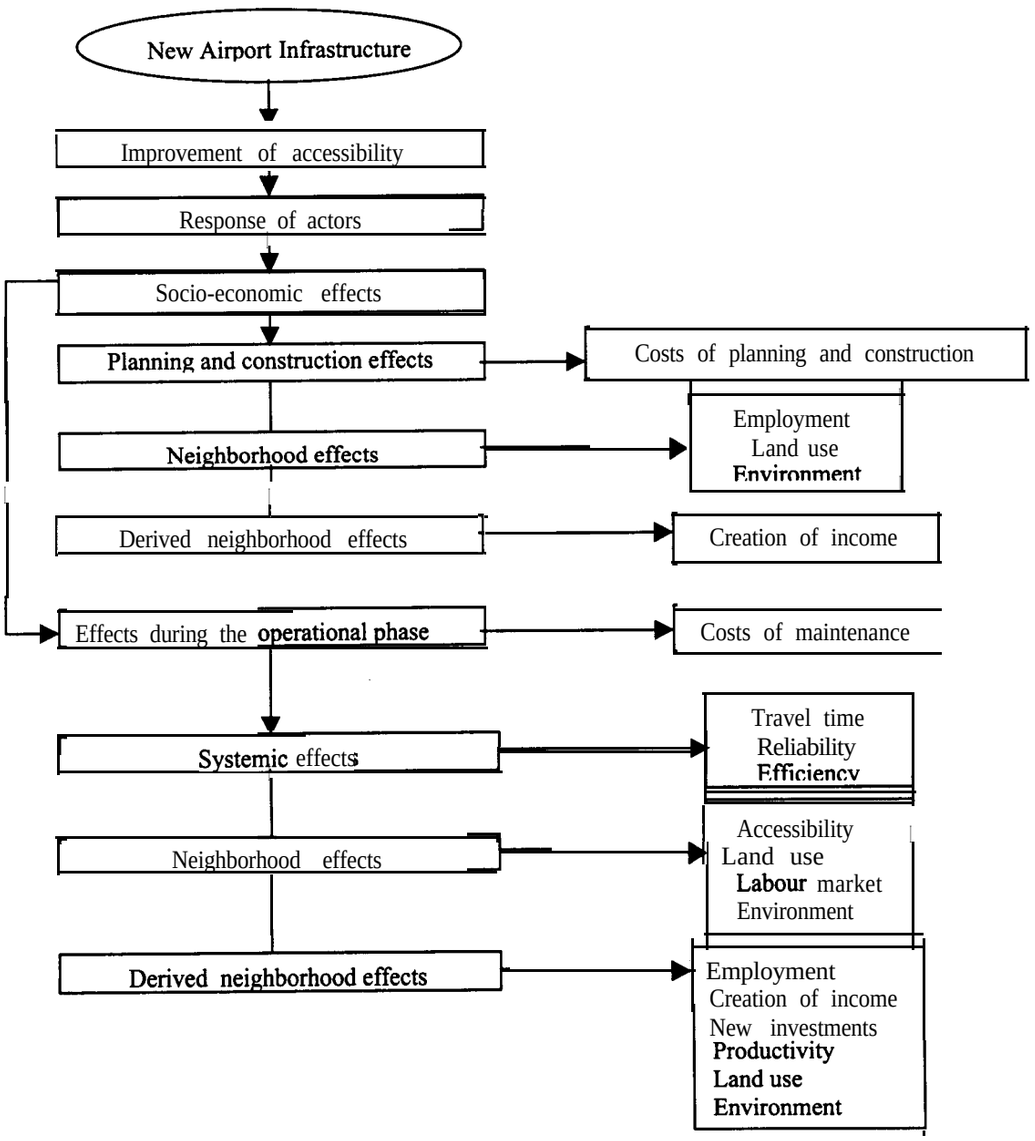

Figure 1. Representation of various effects of new airport infrastructure

Airports fulfil in general two roles (see also Chou 1993 and O'Connor and Scott 1992), viz. an international aviation function as a node in a network that creates economic benefits in terms of revenues for airlines and for the airport itself (including shopping facilities). And secondly, an airport may generate significant spin-off benefits for the wider region (see also Kramer 1990). In principle, both types of benefit may also be generated by an offshore airport, but in most cases the isolated position of an island airport does not favor the creation of significant regional economic spin-off effects because of lack of embeddedness in regional networks. This may lead to an inefficient spatial separation of the infrastructure facility and associated business activities. A clear integration might then need expensive infrastructural provisions with serious land use and environmental consequences, It is thus clear that offshore airports have various types of positive and negative consequences. A concise overview is given in Figure 1. This figure will be used as an analytical framework for assessing the various impacts of island airports.

3. A Pentagon Prism Analysis

In recent years several policy studies on infrastructure and public facilities have been published which have tried to assess the critical success (or failure) factors of policy by using a so-called *pentagon model*. This aims to map out in a structured manner the various forces that contribute to the performance of a given policy (see for details inter alia Nijkamp et al. 1994 and Capello et al. 1998). The basis of this approach is formed by a pentagonal prism, which offers a multi-dimensional perspective on the drivers of a successful policy (see for a visual presentation Figure 2). Normally, five distinct factors are included in such a pentagon prism. These are:

- *Hardware:* the physical and technological construction works of the infrastructure, in particular its degree of sophistication and innovation
- *Software:* the information and communication potential of the infrastructure provision concerned, in particular its broader network connecting potential
- *Orgware*: the degree of managerial, regulatory and organizational competence involved, with a view to enhancing the efficiency and the satisfaction of customers' needs
- *Finware*: the cost-effectiveness and financing aspects of the infrastructure investment, with a particular view to an improvement of the competitive position of the infrastructure facility
- *Ecoware:* the contribution of the infrastructure at hand to an enhancement of ecological quality conditions, in particular from the viewpoint of sustainable development.

As mentioned above, an airport has both an internal aviation network function as a logistic corporate organization and a system-wide function for economic developments in a wider regional context (see Irwin and Kasarda 1991 and Ivy et al. 1995). Both aspects of airports will be addressed in our study by means of the

pentagon prism approach. They will be called the ***corporate*** perspective and the ***regional*** perspective, respectively.

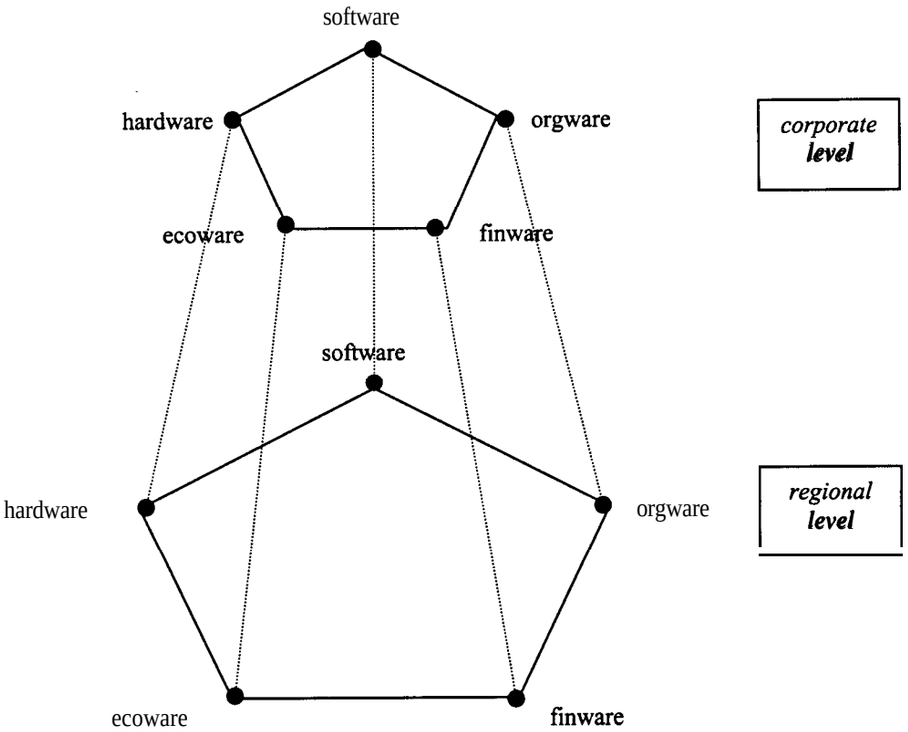

Figure 2. A double-layer representation of the pentagon prism

The various dimensions of the pentagon prism can be assessed by means of various performance indicators, such as employment growth, investment growth, rise in GDP, environmental effects, land use effects, new office locations, accessibility, new high-quality infrastructure etc. In the next two sections the implications of the new airports of Hong Kong and Osaka will be described for the various pentagon factors in the form of a comparative analysis at both the corporate and regional level.

4. Critical Success Factors for Offshore Airports from a Corporate Perspective

On the basis of the pentagon prism the following five classes of critical success factors for offshore airports can be distinguished (see for details also Yim 2000).

4.1 Hardware

An airport on an island is a collection of facilities that serves the entire airport operation. Besides usual necessary facilities such as the air traffic control, the runways, the passenger terminal building and other supporting facilities, also specific

facilities have to be in place. Examples are transport possibilities for evacuation in case of calamities in which ordinary transport possibilities cannot be used. The vulnerability of transport possibilities for the sake of users' safety plays a role in facilitating transport possibilities like ferries. These will be in operation in case of serious accidents, but this contingency option must be well organised in case such accidents occur. Clearly, an isolated offshore location of an airport requires sea rescue facilities that are necessary in case of accidents.

4.2 Software

The most common example of software facilities that support hardware facilities on airports is the air traffic system from which air traffic controllers supervise aircraft movements of landing or departing airplanes. Navigational systems are essential systems within air traffic control processes. These software facilities can also be found at airports on the mainland. The location of an offshore airport in the sea necessarily requires systems that can detect wind shear. Wind shear, a sudden change of direction of wind, needs to be detected in order to pass the information timely to the crew of an airplane.

4.3 Orgware

Several interest groups are involved with the airport's business. Besides parties that can be categorised into supply and demand, there are also parties that take care of the supervision of the airport. The airport authorities are responsible for executing the activities of the airport: they are suppliers of the airport's services. The airlines, which in turn supply passengers and the cargo operators, make use of the services of the airport. They will aim to get low airport tariffs. The position of the airport is that of a supplier which aims to maintain or extend the number of its customers, the airlines, in order to process more passengers and cargo. The availability of capacity to airlines that wish to use the airport is essential to offshore airports, since capacity is a factor in which the airport authorities can expand without problems like noise pollution for people who live in the neighbourhood. The ability to attract airlines without harming the competitive position of the airport is important for the viability of offshore airports.

4.4 Finware

The process of exploiting and developing specifically offshore airports is something that differs from airports on the mainland. The high costs of constructing an airport must be paid back. The pay-back period depends on the government's policy and the role of private investors that have supplied financial capital. These costs will immediately have an effect on the tariffs of the airport users, like airlines. The danger of downsizing of the tariffs on the ultimate users, the passengers, may of course affect ticket prices and hence demand.

A conflict of interest between short-term business profitability that can be at odds with the competitive position of the airport must be evaluated against the policy of the government. The underlying idea is that the government must make a choice between the interest of the airport as common good on the one hand and the corporate entity of an airport on the other hand.

4.5 Ecoware

A clear policy about environmental quality is important, since the airport is a source where noise pollution is a significant side effect. Also the use of substances that are environmentally dangerous such as kerosine is a concern. Processes that favour environmental awareness have to be channeled and stimulated. Besides attention for environmental issues on the airport itself, the focus can also be placed on environmental effects in the near vicinity of the airport, such as health checks amongst the nearest communities. Clearly, offshore airports have effects on both marine and terrestrial ecology.

5. Critical Success Factors for Offshore Airports from a Regional Perspective

In this section we will follow our pentagon prism approach in a way similar to the previous section by addressing regional development issues (see also Graham and Guyer 2000 and Walser 1988).

5.1 Hardware

Hardware factors from a regional economic point of view concern the physical lay-out of the transport infrastructure in the vicinity of the offshore airport. The presence of various modes of transport needs to be seen in relationship with the airport: the accessibility of the offshore airport is of critical importance. In the vicinity of airports – mostly located in the neighbourhood of major traffic junctions – the presence of logistic companies is rather common. A well-developed logistic system brings along trade possibilities for the region. The location of an offshore airport differs from an ‘ordinary’ airport. The infrastructure towards an offshore airport leads to a ‘dead end’; viz. the offshore airport itself. Infrastructure with various modes of transport with features of user-friendliness will be beneficial to the airport. Not only is this a base for a logistic system to be developed, offering trade possibilities for the region, but also the urban development and development of business centres along the infrastructure will benefit. Aspects like safety and vulnerability of the transport infrastructure are of eminent importance to the regional analysis of hardware. The extent of vulnerability of the transport infrastructure to an offshore airport not only depends on the number of modes of transport to the offshore airport, but also on the number of hardware facilities that provides this number of transport modes. A single connection between the mainland and the offshore airport will decrease the accessibility of the offshore

airport in case of accidents obstructing the passage to the airport. Clearly, there may be opportunities to develop sea terminals to offer integration possibilities with the logistic and economic system in the region.

5.2 Software

Software factors that concern offshore airport are, for example, advanced facilities that support the transport infrastructure to and from the airport island. The vulnerability of the land link to the offshore island will greatly benefit from this support. Important traffic junctions on vulnerable locations receive benefits from the availability of such software facilities. Information systems such as route guidance systems are a good example of these facilities. A route guidance system watches over the operational execution of the infrastructure, but also over the user of the infrastructure. Should any disasters or calamities occur, the user can be informed by electronic signs on the road about the current road situation and can be advised about the possible delay or alternative routes to the airport. This typical information system applicable to road use is a software facility that is not only concerned with road use, but also with the services of the airport; examples are the so-called electronic data provisions on the road that direct the user towards the right gate and the right airline. The traffic flow is managed in an efficient way when users approach the airport. Other software facilities available on modes of transport such as the sub-way or shuttle trains are facilities that provide the user with relevant information about the airport. Examples of these facilities are information about delays, arrival and departure times. etc.

5.3 Orgware

The planning, implementation and co-ordination of transport infrastructure in the vicinity of offshore airports is quite a difficult job. The possibility to construct new infrastructure to facilitate the offshore airport provides unique opportunities to design the area in a proper way. This requires a good co-ordination between the various parties involved in the planning and implementation of the airport. First of all, it is of importance to formulate clear development goals for the area in the vicinity of the airport. This area does not only cover the airport island, but also the area on the mainland that makes the infrastructure possible. Next, the various modes of transport need to be examined in relation to the traffic flows, taking into account the policy chosen. The aimed distribution of modes of transport by rail, road, sub-way or the sea connections with the coast etc., must be envisaged in the transport infrastructure of the new airport, while extension of the transport infrastructure must be kept open as a possibility.

5.4 Finware

The way of financing large infrastructure projects such as an offshore project is not an insignificant point. It involves considerable amounts of money. The government,

whether or not in combination with private parties such as institutional investors, banks, pension funds etc., needs to realise that when costs are not controlled, the execution of such a large project might exceed the sum of money expected and make further extension impossible. Also, one has to take into account that maintenance of such a large project will cause high costs. Users of infrastructure can of course contribute by paying toll when using this infrastructure. In general, the infrastructure that is needed to open up a connection between the offshore island and the mainland and additional infrastructure, is essential for the accessibility of an airport. It is possible that institutional investors can attribute to the investments in infrastructure. Raising toll on the infrastructure can be a way to pay back to institutional investors their contributions. Issues on the cost and revenue structure of infrastructure must be taken into account as well.

5.5 Ecoware

The transformation of the area in the vicinity of the offshore airport and its related infrastructure has, logically, implications for the ecology. It is possible that in pessimistic scenarios negligence of nature and the environment would result in implications that will threaten species with extinction. An offshore airport has first of all implications for the marine ecology by the fact that reclamation work must be executed in order to create the airport island. Secondly, the development of the area that is in the vicinity of the airport, with investments like infrastructure, has also a significant influence on land ecology. During the construction period, mitigation methods and techniques that put less pressure on sea and land ecology are aimed at. Aspects such as safety for man and species, or an economic use of energy during the construction of the hardware facilities such as the airport island and the infrastructure will contribute towards an environmentally-aware building process.

6. The Pentagon Prism Factors for Offshore Airports as a Corporate Activity

On the basis of the five above described pentagon prism factors and by using also Figure 1 as a general framework for empirical assessment, the various factors could be approximated and estimated by means of policy documents, consultancy reports, and in depth interviews with officials and government representatives (see for details Yim 2000). For the ease of presentation and for the sake of comparative evaluation we have included in the assessment Table 1 only the qualitative indicative results for both Hong Kong and Osaka.

Pentagon Prism Factors	Performance indicators for critical success analysis	Hong Kong	Osaka
Hardware	Availability of emergency facilities	+/-	x
	Expansion possibilities for carriers		x
Software	Degree of innovativeness of software facilities	+/-	x
	Presence and quality of facilities for the client	+/-	x
Orgware	Managerial flexibility of aviation authorities	+/-	x
	Organizational cooperation among stakeholders	+	+
Finware	Service of airport revenues		x
	Profitability prospects of airport	x	-
	Level of landing fees	+	+
	Possible downsizing of fees towards travelers	+	x
Ecoware	General environmental policy of airport	+	+
	Procedures for handling dangerous material	+	+/-
	Chance on accidents with environmental effects	x	x
	Design and presence of environmental audit	+/-	x

Table 1. An assessment of the pentagonal success factors from a corporate viewpoint

Legend: +: positive or abundantly present
-: negative or hardly present
x: information is hard to obtain or to interpret

The final viability seems to be one of the most severe bottlenecks of offshore airports. This is witnessed by the high landing fees in Hong Kong and Osaka, which belong to the highest in the world. This is caused by the extremely high construction costs and the long pay-back period. As a consequence, it may be extremely difficult to turn an offshore airport into a profitable hub. In the case of Osaka, the prospects are not yet favourable, while for Hong Kong the development is mainly dependent on the relationship between Hong Kong and mainland China. Furthermore, the environmental impacts are not negligible.

7. The Pentagon Prism Factors for Offshore Airports in a Regional Setting

The broader regional consequences of both airports envisaged deserve also profound consideration. Of course there are significant differences between the two airports at hand. The new airport of Hong Kong has been designed with a view to future expansion on the island Check Lap Kok (including the construction of new sophisticated infrastructure to the city). In the Osaka case, future expansion was less envisaged, so that aviation authorities were soon forced to change the original design

and to plan for a second runway. In the meantime, also Osaka is planning further regional economic development, inter alia by building a business park on the mainland which should in the long run turn into an international trade centre. In the case of Hong Kong, also urban expansion by residential areas is foreseen. Apart form the sophisticated new infrastructure, also the new container terminal and the new Disneyland may contribute to a favourable regional development. In conclusion, the airport plans in Hong Kong reflect a more integrated concept than those in Osaka, so that in Hong Kong the new island airport may clearly function as a regional catalyst. Table 2 offers a qualitative review of the various pentagon factors assessed by means of field work, interviews, grey material and so forth (see Yim 2000).

Pentagon Prism Factors	Performance indicators for critical success analysis	Hong Kong	Osaka
Hardware	Investment efforts	+	+
	Degree of congestion	+	x
	Accessibility and travel time	+	+/-
Software	Innovative potential of software	+	x
Orgware	Employment during airport construction	+	x
	Contribution to business development	+	-
	Coordination among stakeholders	+	+/-
Finware	Private investments	+	+/-
	Relative land price level near airport	+	+
Ecoware	Noise annoyance for citizens	-	+
	Impact on flora and fauna	+/-	x

Table 2. An assessment of the pentagonal success factors from a regional viewpoint

8. Concluding Remarks

It is evident that an island airport is a complex policy issue with a great many strategic aspects, not only for the logistic operation of the facility but also for the wider regional context. The investigation of the potentials and the impediments at both Osaka and Hong Kong airport have led to interesting lessons and findings.

First, island airports have generally weak links with the mainland and need, therefore , expensive evacuation facilities (rescue and transport facilities).

The new transport links from the mainland to the airport have to be well accessible and need sophisticated route guidance systems and advanced telematics services. Information is of key importance.

An island airports is not a separate logistic location, but needs to be integrated in regional development patterns in order to generate sufficient economic spin-offs. Thus, a catalyst function is crucial.

Given the excessively high costs involved, a sound financing scheme and strict agreements with financiers are a condition sine qua non. Clearly, user charge principles may be helpful in creating a sound financial basis.

The environmental implications on both the sea and the land side may be rather severe. To reduce negative impacts on both marine and terrestrial ecosystems, many mitigation techniques are necessary, which may once more lead to a rise in the costs of offshore airports.

It is clear that a new offshore airport will face serious profitability problems, if the old airport on the mainland is not closed down. The case of Osaka is illustrative in this context.

In general, offshore airports do have less opportunity for attracting customers for other purposes than just travelling. This puts such airports in a feeble position compared to mainland airports which have direct links to city centres, thus serving much more the needs of tourists.

To conclude, offshore airports may be a solution for serving the needs of travelers in congested areas, but the direct and indirect private and social costs tend to be rather high. This renders the prospects of such concepts in aviation policy in densely populated areas as a general panacea rather feeble.

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